ACCORDING TO ALL PUNJAB & KPK BOARDS

New Edition 2023

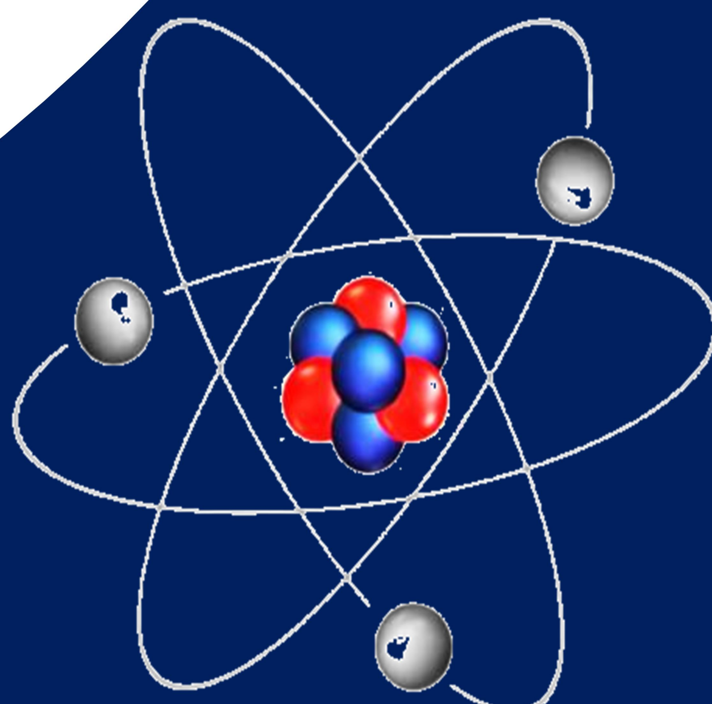
@AIMERS Series

SMART PHYSICS

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OBJECTIVES + SUBJECTIVES

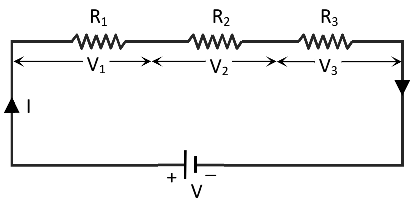
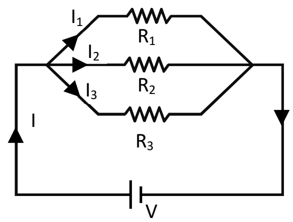
For Class XI, XII & NMDCAT



SMART PUBLICATIONS

NMDCAT Series

COMBINATION OF RESISTORS

SERIES Combination	PARALLEL Combination
	
• Only one path for the flow of current	• More than one paths for the flow of current
• Same current passes through each component	• Current is divided through each component
• Potential difference is different across each component	• Potential difference is same across each component
• R_{eq} is larger than the individual largest resistance in the circuit.	• R_{eq} is smaller than the individual smallest resistance in the circuit.
• $R_{eq} = R_1 + R_2 + \dots\dots\dots + R_n$	• $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots\dots\dots + \frac{1}{R_n}$
• In n identical resistance, connected in Series: $R_{eq} = nR$ and current through each resistance $V' = \frac{V}{n}$.	• In n identical resistance, connected in parallel $R_{eq} = \frac{R}{n}$ and current through each resistance $I' = \frac{I}{n}$.

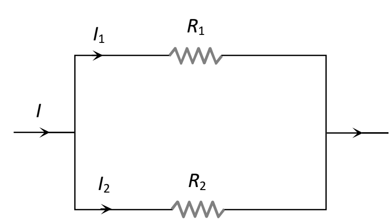
❖ *In all combinations of resistors; law of conservation of energy and charge are applicable.*

- If two resistance in parallel,

$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2} = \frac{Multiplication}{Addition}$$

- **Current through any resistance:**

$$I' = I \times \left[\frac{\text{Resistance of opposite branch}}{\text{Total resistance}}\right]$$

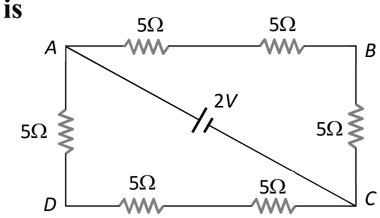


In the given circuit: $I_1 = I\left(\frac{R_2}{R_1+R_2}\right)$ and $I_2 = I\left(\frac{R_1}{R_1+R_2}\right)$

✍ Using n conductors of equal resistance, the number of possible combinations is 2^{n-1}.
✍ If the resistance of n conductors are totally different, then number of possible combinations will be 2^n.
✍ If n identical resistances are first connected in series and then in parallel, the ratio of the equivalent resistance is given by $\frac{R_p}{R_s} = \frac{n^2}{1}$.
✍ If a wire of resistance R, cut in n equal parts and then these parts are collected to form a bundle then equivalent resistance of combination will be $\frac{R}{n^2}$.

PRACTICE PROBLEMS

1. The potential difference between points A and B of adjoining figure is



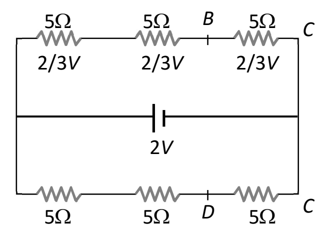
(a) $\frac{2}{3}V$

(b) $\frac{8}{9}V$

(c) $\frac{4}{3}V$

Solution: (c)

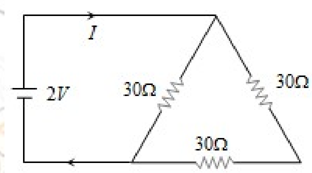
The given circuit can be redrawn as follows



For identical resistances, potential difference distributes equally among all.

Hence potential difference across each resistance is $\frac{2}{3}V$, and potential difference between A and B is $\frac{4}{3}V$.

2. The current in the adjoining circuit will be



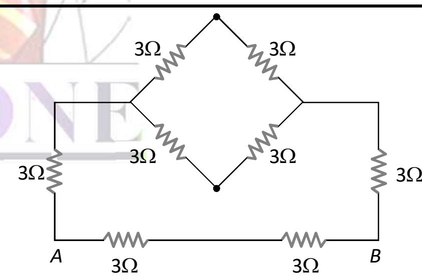
(a) $\frac{1}{45}$ *ampere* (b) $\frac{1}{15}$ *ampere*

(c) $\frac{1}{10}$ *ampere* (d) $\frac{1}{5}$ *ampere*

Solution: (c)

$$R_{\text{equivalent}} = \frac{(30+30)30}{(30+30)+30} = \frac{60\times 30}{90} = 20\Omega \qquad \therefore I = \frac{V}{R} = \frac{2}{20} = \frac{1}{10} \textit{ampere}$$

3. Equivalent resistance between A and B will be:



(a) 2 *ohm*

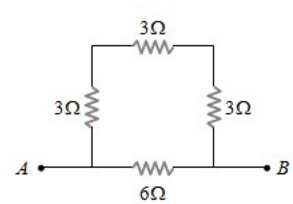
(b) 18 *ohm*

(c) 6 *ohm*

(d) 3.6 *ohm*

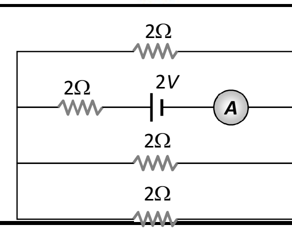
Solution: (d)

The circuit reduces to



$$R_{AB} = \frac{9\times 6}{9+6} = \frac{9\times 6}{15} = \frac{18}{5} = 3.6\Omega$$

4. The reading of the ammeter as per figure shown is



(a) $\frac{1}{8}A$ (b) $\frac{3}{4}A$

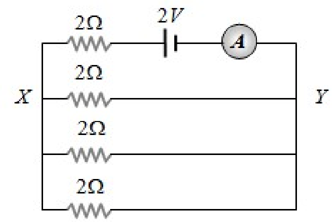
(c) $\frac{1}{2}A$ (d) 2 A

Solution: (b)

Resistance across $XY = \frac{2}{3}\Omega$

Total resistance $= 2 + \frac{2}{3} = \frac{8}{3}\Omega$

Current through ammeter $\quad I = \frac{2}{8/3} = \frac{6}{8} = \frac{3}{4} A$



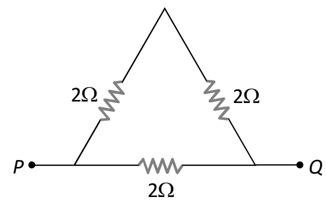
5. **Three resistors each of 2 *ohm* are connected together in a triangular shape. The resistance between any two vertices will be**

(a) 4/3 *ohm* (b) 3/4 *ohm*
(c) 3 *ohm* (d) 6 *ohm*

Solution: (a)

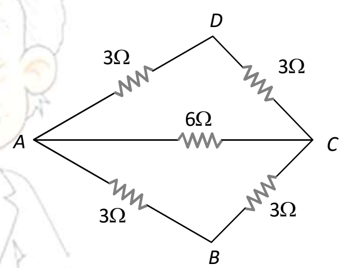
Equivalent resistance of the combination

$$R_{eq} = \frac{(2+2)\times 2}{2+2+2} = \frac{8}{6} = \frac{4}{3}\Omega$$



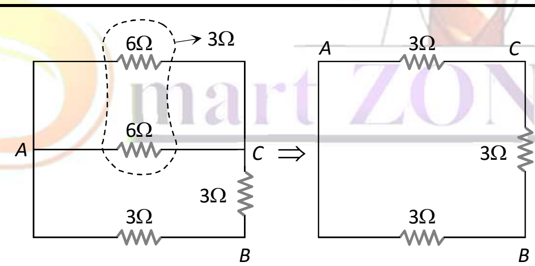
6. **The effective resistance between the points A and B in the figure is**

(a) 5Ω
(b) 2Ω
(c) 3Ω
(d) 4Ω



Solution: (b)

Given circuit is equivalent to



So the equivalent resistance between points A and B is equal to $R = \frac{6\times 3}{6+3} = 2\Omega$

7. **Resistors of 1, 2, 3 *ohm* are connected in the form of a triangle. If a 1.5 volt cell of negligible internal resistance is connected across 3 *ohm* resistor, the current flowing through this resistance will be:**

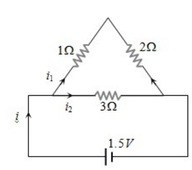
(a) 0.25 *amp* (b) 0.5 *amp*
(c) 1.0 *amp* (d) 1.5 *amp*

Solution: (b)

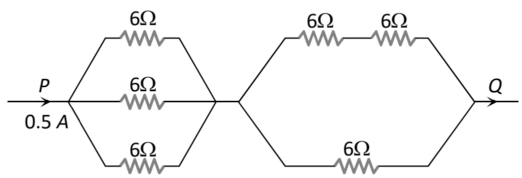
$$i_1 + i_2 = \frac{1.5}{3/2} = 1\,amp$$

$$\frac{i_1}{i_2} = \frac{3}{3}$$

$\Rightarrow i_1 = i_2 \quad \therefore \quad i_2 = 0.5A = i_1$



8. Resistances of 6 *ohm* each are connected in the manner shown in adjoining figure. With the current 0.5 *ampere* as shown in figure, the potential difference $V_P - V_Q$ is

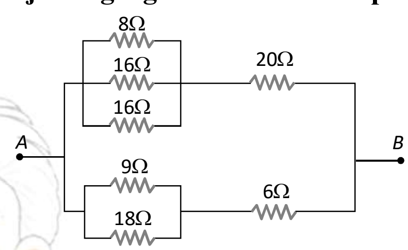


(a) 3.6 V
(b) 6.0 V
(c) 3.0 V
(d) 7.2 V

Solution: (c)

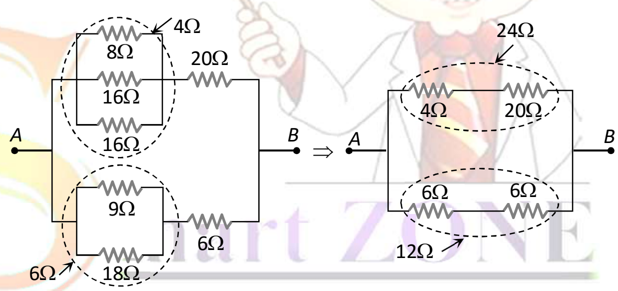
$$V_p - V_q = \left(\frac{6}{3} + \frac{12\times 6}{12+6}\right)(0.5) = (2+4)(0.5) = 3V$$

9. The equivalent resistance of the arrangement of resistances shown in adjoining figure between the points *A* and *B*



(a) 6 *ohm*
(b) 8 *ohm*
(c) 16 *ohm*
(d) 24 *ohm*

Solution: (b)



$$R_{AB} = \frac{24\times 12}{(24+12)} = 8\Omega$$